



**ERA-HELICOPTERS, INC.**

GULF COAST DIVISION  
LAKE CHARLES, LOUISIANA

## PROCESS SPECIFICATION

PROCESS SPECIFICATION NUMBER: ERA-1024

BO-105 C 20 R ENGINE INSTALLATION

FABRICATION OF THE ENGINE AIR INLET

PREPARED BY:

*John E. Stanley*  
John E. Stanley  
MESH COMPOSITES INC.

DATE: 1/18/88

### APPROVALS

MANUFACTURING	QUALITY CONTROL	ENGINEERING	
<i>Leroy W. Dachem</i> <i>LeRoy Dachem</i>	<i>John E. Stanley</i> <i>John Murphy</i>	<i>Bart E. Engle</i> <i>P.A. Schaeff, Jr.</i>	MESH ERA



**HELICOPTERS, INC.**  
GULF COAST DIVISION

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# **PROCESS SPECIFICATION**

**Scope:** This specification outlines the requirements for fabricating the engine air inlet for the C 20 R engine for the BO-105

**Conformation:** This specification does not conform to any existing government specification.

**Subcontractors:** MESH COMPOSITES INC. of Lake Charles, Louisiana, or its subcontractor shall be the only subcontractors qualified to construct the FRP requirements and shall comply with this process specification. Any deviations or variations are to be submitted to ERA for approval with proper documentation prior to fabrication.

**Conflicts:** In the event of a conflict with engineering drawing(s) and this specification, the drawing(s) shall govern.

## Fabrication of the Engine Air Inlet for the C 20 R Engine for the BO-105

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MATERIALS

<u>MATERIALS</u>	<u>NAME</u>	<u>MANUFACTURER</u>
Resin	Derakane 8084	Dow Chemical Midland, MI
Promoter	Cobalt Napthenate	AKZO Chemie New Brunswick, NJ
Accelerator	Dimethylaniline	Buffalo Colors West Paterson, NJ
MEKP Catalyst	Hi Point 90	Witco Chemical Richmond, CA
	Lupersol DHD 9	Lucidol Chemical Buffalo, NY
Mold Release	PVA	Rexco Carpenteria, CA
	Cerea Mold Release Wax	Ceara Products, Inc. Denver, CO
UV Inhibitor	UV-9	Industrial Chemicals Atlanta, GA
Pigment	CoPlas pigment	CoPlas Fort Smith, AR
	Spartan pigment	Spartan Pigments Houston, TX
Gel Coat	Gel Coat	CoPlas Inc. Ft. Smith, Ark.



ERA PS 1024REV IRDATE 1/18/88MATERIALS

<u>MATERIALS</u>	<u>NAME</u>	<u>MANUFACTURER</u>
3/4 oz Type "E" glass mat	M113 - 3/4 oz.	Certainteed Wichita Falls, TX
1-1/2 oz Type "E" glass mat	Compatamat - 1-1/2 oz.	PPG Industries Shelby, NC
	M113 - 1-1/2 oz.	Certainteed Wichita Falls, TX
8.9 oz. Type "ECDE" glass	7781	Burlington Fibers Altavista, VA
10 mil "C" glass, or	Modiglass	Reichold Chemical Bremen, OH
	Manville Glass	Manville Corp. Denver, CO
10 mil "A" glass veil	Surglass	Superior Glass Bremen, OH
Fire Retardant Additive	Nyacol APE-1540	PQ Corp. Ashland, Ma.
Fire Retardant Additive	Decabromodiphenyl Oxide	Ethyl Corp. Magnolia, Ark.

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MATERIALS

<u>MATERIALS</u>	<u>NAME</u>	<u>MANUFACTURER</u>
Grinding Discs	36 Grit Type D 60 Grit Type C 80 Grit Type C	3M Corp. St. Paul, MN
Mold Surface	Black Tooling Gel	Glidden

Laminate Manufacture - Part A

- 1) Inspect mold for defects (ie. chips, cracks, crazing, etc. ....).  
DO Not proceed until any defect is corrected.
- 2) Apply mold release agent(s) according to manufacturer's instructions.
- 3) Apply gel-coat containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, pigment and UV inhibitor onto mold using a spray gun for a nominal thickness of 10 mils, minimum thickness of 6 mils.
- 4) Allow gel-coat to cure for 4 - 6 hours and become tack free.
- 5) Apply one layer of 3/4 oz. chopped strand mat on mold surfaces. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Degaerate with serrated rollers.
- 6) Apply one layer of ECDE glass cloth. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Degaerate with serrated rollers.
- 7) Apply 2nd layer of 3/4 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Degaerate with serrated rollers.
- 8) Apply 2nd layer of ECDE glass cloth. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Degaerate with serrated rollers.
- 9) Apply 3rd layer of 3/4 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Degaerate with serrated rollers.
- 10) Allow to cure for 4 - 6 hours. Separate from mold and trim to size.

Laminate Manufacture - Part B - Flat stock made  
on flat mold.

- 1) Inspect mold for defects (ie. chips, cracks, crazing, etc. ....).  
DO Not proceed until any defect is corrected.
- 2) Apply mold release agent(s) according to manufacturer's instructions.
- 3) Apply one layer of 1 1/2 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Daeaerate with serrated rollers.
- 4) Apply 2nd layer of 1 1/2 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Daeaerate with serrated rollers.
- 5) Apply 3rd layer of 1 1/2 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Daeaerate with serrated rollers.
- 6) Apply 4th layer of 1 1/2 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Daeaerate with serrated rollers.
- 7) Apply 5th layer of 1 1/2 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Daeaerate with serrated rollers.
- 8) Apply 6th layer of 1 1/2 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Daeaerate with serrated rollers.
- 9) Allow to exotherm and cool.
- 10) Apply 7th layer of 1 1/2 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Daeaerate with serrated rollers.

Laminate Manufacture - Part B - Cont.

- 11) Apply 8th layer of 1 1/2 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 12) Apply 9th layer of 1 1/2 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 13) Apply 10th layer of 1 1/2 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 14) Apply 11th layer of 1 1/2 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 15) Apply 12th layer of 1 1/2 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 16) Separate from mold and trim to size.

Laminate Manufacture - Part C

- 1) Inspect mold for defects (ie. chips, cracks, crazing, etc. . .). DO NOT proceed until any defect is corrected.
- 2) Apply mold release agent(s) according to manufacturer's instructions.
- 3) Apply one layer of 3/4 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 4) Allow to cure 4 - 6 hours. Separate from mold and trim to size.

Laminate Manufacture - Part D

- 1) Using flat stock form Part B cut out 2 pieces using the master pattern.
- 2) Sand each piece using 40 grit sandpaper.

Laminate Manufacture - Part D - Cont.

- 3) Apply one layer of 3/4 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 4) While the mat is wet clamp the pieces together. Allow to harden and trim to size.

Assembly of Part

- 1) Confirm that Part B is trimmed properly by fitting into position.
- 2) Sand inside of Part A where bonding will occur with 40 grit sandpaper.
- 3) Apply one layer of 3/4 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 4) Position part B in Part A while mat is still wet. Allow to harden.
- 5) Dress down any rough areas using 40 grit sandpaper.
- 6) Confirm that Part C is trimmed properly by positioning in Part A.
- 7) Once proper fit has been achieved apply one 3/4 oz. chopped strand mat tying Part C to Part A and Part B. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 8) Apply 2nd layer of 3/4 oz. chopped strand mat. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 9) Allow to harden and dress down any rough areas.

Assembly of Part - Cont.

- 10) Fit Part D in Part A as shown on Drawing #10572-101-001 to confirm proper fit.
- 11) Apply one 3/4 oz. chopped strand mat in position where Part D fits into Part A. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 12) While mat is still wet, fit part D into place and allow to harden.
- 13) Apply one 1 1/2 oz. chopped strand mat to both sides. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 14) Apply 2nd 1 1/2 oz. chopped strand mat to both sides. Saturate with Derakane 8084 resin containing 12% by weight Decabromodiphenyl Oxide, 7.5% by weight Nyacol APE 1540, UV inhibitor and pigment. Deaerate with serrated rollers.
- 15) Allow to cure for 4 - 6 hours. Dress down any areas of roughness.
- 16) Machine surfaces in accordance with Drawing #10572-101-001.
- 17) Install threaded inserts in accordance with Process Specification 1023.

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## INSPECTION

It is the purpose of the inspection to verify that each part has been fabricated in accordance with and meets the requirements of this specification.

**RESPONSIBILITIES:** It is the responsibility of the fabricator to make available to ERA Helicopter or its authorized representative any or all of the following:

**Records:** Records pertaining to the part(s) being purchased shall be supplied when requested. These may include:

- Materials specifications
- Equipment drawings or mold jig
- Materials test results.
- Dimensional verification reports.
- Rework and repair reports.

### MATERIALS:

Raw materials used for laminates shall be virgin materials and shall be free of contaminates as described on pgs. 14, 15, 16, and 17.

**FABRICATED PARTS:** The part to be inspected shall be properly located and positioned, and shall be in condition to permit safe and thorough inspection. Reasonable means shall be provided to permit the inspector to visually examine the entire inner and outer surfaces of the part.

Allowable defects are listed on pgs. 12 and 13.

The following inspection tools and equipment shall be made available for use by the inspector.

- Barcol hardness tester.
- Acetone squeeze bottle with acetone.
- Extension cord with ground fault switch.
- A vapor tight inspection light.
- Thickness gauge.

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## INSPECTION

### TEST OF FINISHED

#### PARTS:

The following basic tests shall be included as a minimum in the Acceptance Inspection.

Barcol Hardness Test - A test of resin cure shall be made in accordance with ASTM D2583. Take 10 readings, discard highest and lowest, average the remaining readings. Minimum acceptable average reading is 30.

Surface Cure Test - An acetone test shall be used to detect surface inhibition on the surfaces exposed to air during cure. The procedure that shall be used is the following: rub a few drops of acetone on the surface and check for tackiness after the acetone has evaporated. Persistent tackiness indicates incomplete cure.

Dimensions - The inspector shall be provided with copies of all approved drawings or mold jigs.

### OTHER APPLICABLE DOCUMENTS:

ASTM Standards

C 581-74-Test Method for Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures.

D 638-77a-Test Method for Tensile Properties of Plastics.

D 790-71-Test Methods for Flexural Properties of Plastics and Electrical Insulating Materials.

D 883-78a-Definitions of Terms Relating to Plastics.

D 2583-75-Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

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## ALLOWABLE DEFECTS

Defect	Surface inspected
Cracks (through part)	None
Crazing (fine surface cracks)	Max dimension 1/2 in., max density 5 per sq. ft. min 2 in apart
Blisters (rounded elevations of the laminate surface over bubbles)	Max 1/4 in., dia x 1/8 in high, max 1 per sq ft, min 2 in apart
Wrinkles and solid blisters	Max deviation, 20% of wall thickness but not exceeding 1/8 in.
Pit (craters in the laminate surface)	Max dimensions, 1/8 in dia x 1/16 in deep, max density 10 per sq. ft.
Surface porosity (pin-holes or pores in the laminate) 10 per sq. ft.	Max dimensions, 1/16 in dia. x 1/16 in deep, max density
Chips	Max dimensions of break, 1/4 in, and thickness no greater than 20 percent of, wall thickness, max density 1 per sq ft
Dry spot (nonwetted reinforcing)	Max dimension, 2 sq in. per sq ft
Entrapped air (bubbles or voids in the laminate)	1/8 in. max dia, 4 per sq in. max density; 1/16 in. max dia. 10 per sq in. max density.

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**ALLOWABLE DEFECTS**

<b>Defect</b>	<b>Surface inspected</b>
Exposed Glass	None
Burned Areas	None
Exposure of cut edges	None
Scratches	Max length 1 in. max depth 0.010 in.
Foreign Matter	1/16 in. dia., max density 1 per sq ft

## FIBERGLASS CHOPPED STRAND MAT

## 1.0 Scope

1.1 The scope of these procedures is to describe the visual, physical and mechanical parameters which characterize fiberglass chopped strand mat used by the fabricator.

## 2.0 Definitions

2.1 Chopped Strand Mat - Chopped strand mat is made from randomly oriented glass strands which are held together in mat form using a binder. Each strand contains a sizing.

## 3.0 Requirements

3.1 Visual Requirements - Each roll of chopped strand mat shall be inspected to insure it is consistent in color, texture and appearance. It shall be free from surface irregularities, fluffy masses, dirt spots or other foreign material; water spots, knots, binder spots larger than 2" in diameter, clumps of strands and tears of holes which may result from removal of defects.

## 3.2 Physical Requirements

3.2.1 Weight - The square foot weight of the mat shall be measured for each carton of mat used. All specimens shall fall within the range specified for the product.

3.3 Packaging Requirement - Packaging shall be visually inspected to assure proper labeling and that the package is free from damage that may render the mat unusable.

3.3.1 The mat shall be packaged in an unbroken carton as shipped from the mat manufacturer's factory. The mat used shall not be repackaged in the distribution of the mat after the manufacturer has shipped the mat.

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FIBERGLASS CHOPPED STRAND MAT

3.4 Documentation - It is the responsibility of the fabricator to maintain records showing the results of all material testing. This information shall show at a minimum, the following:

- (a) Form of material
- (b) Manufacturer
- (c) Manufacturer's product description including binder type (treatment)
- (d) Manufacturer's product code
- (e) Production date, if available, or production code on carton
- (f) Property measured and value recorded
  - \* Visual inspection
  - \* Width
  - \* Thickness
  - \* Packaging
- (g) Job number (Internal Fabricator Control Number)
- (h) Fabricated part identification number

## FIBERGLASS WOVEN ROVING

## 1.0 Scope

1.1 The scope of these procedures is to describe the visual, physical and mechanical parameters which characterize woven roving used by the fabricator.

## 2.0 Definitions

2.1 Fiberglass Woven Roving - Glass fiber rovings woven into a heavy weight fabric.

2.2 Wrap Ends - The rovings which run in the longitudinal direction of the fabric, i.e., along the roll length of the fabric.

2.3 Fill Picks - The rovings which run in the transverse direction of the fabric, i.e., across the roll length of the fabric.

2.4 Leno Strands - A pair of warp ends at each edge of the woven fabric. One Leno warp end is always over each fill pick while the other Leno warp end is always under the fill pick. The Leno strands define the edges of the woven field and serve to stabilize the edges of the fabric.

## 3.0 Requirements

## 3.1 Visual Requirements

3.1.1 Dirt Spots - Defined as all foreign matter, dirt, grease spots, etc. - The average number of dirt spots (1/16" to 3/4" in diameter) per 100 lineal feet shall be 6 or less. All rolls shall be free of dirt spots in excess of 3/4" diameter.

3.1.2 Warp Ends - All rolls shall be free of missing warp ends for more than two consecutive feet.

3.1.3 Fill Picks - All rolls shall be free of consecutive missing picks in excess of five, or more than eleven missing picks, either individual picks or any combination of individual and multiple (2, 3, 4, or 5) picks, in any consecutive 100 lineal feet.

3.1.4 Fuzz Clumps and Loops - The product is designed to exhibit proper laydown and shall be free of fuzz clumps or loops exceeding one inch in height from the surface.

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## FIBERGLASS WOVEN ROVING

### 3.2 Physical Properties

3.2.1 Thickness - The thickness of the mat in each roll of woven roving shall be measured.

3.3 Packaging Requirement - Packaging shall be visually inspected to assure proper labeling and that the package is free from damage that may render the woven roving unusable.

3.3.1 The woven roving shall be packaged in an unbroken carton as shipped from the manufacturer's factory. The woven roving used shall not be repackaged in the distribution of the woven roving after the manufacturer has shipped the woven roving.

3.4 Documentation - It is the responsibility of the fabricator to maintain records showing the results of all material testing. This information shall show at a minimum, the following:

- (a) Form of material
- (b) Manufacturer
- (c) Manufacturer's product description including binder type (treatment)
- (d) Manufacturer's product code
- (e) Production date, if available, or production code on carton.
- (f) Property measured and value recorded
  - \* Visual inspection
  - \* Width
  - \* Thickness
  - \* Packaging
- (g) Job number (Internal Fabricator Control Number)
- (h) Fabricated part identification number